

DISCUSSION OF THE INCIDENTAL SOCKEYE HARVEST IN THE SHUMAGIN
ISLANDS SECTION POST-JUNE FISHERY

A Report to the Alaska Board of Fisheries
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By:

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INTRODUCTION

There is a general concern over the recent increase in sockeye catches in the Shumagin Islands Section post-June fishery when the South Unimak and Shumagin Islands June Salmon Management Plan (ADF&G 1989) is no longer in effect. Post-June sockeye catches in the Shumagin Islands Section have been averaging 356,435 salmon annually since 1986, which is nearly four times greater than the 1960-85 average of 96,429 salmon (Table 1). The Board of Fisheries has several proposals before it which address this issue. This report provides information to assist the Board of Fisheries in its deliberation on the Shumagin Islands Section post-June fishery. Specifically reviewed in this report are: (1) historical abundance of Western and Upper Cook Inlet sockeye salmon; (2) sockeye migration through the Shumagin Islands Section based on tagging data; (3) catch statistics from the Shumagin Islands Section; (4) age composition of catches; and (5) potential stock composition of the Shumagin Islands Section catches based on run timing considerations.

The Shumagin Islands Section of the Alaska Peninsula Management Area is centrally located in North Pacific waters (Figure 1). The South Peninsula portion of the Alaska Peninsula Management Area extends westward from Kupreanof Point to Scotch Cap. Bordering the South Peninsula area is the North Peninsula area to the north, and the Chignik Management Area to the east. In proximity to the Shumagin Islands are the Bristol Bay, Kodiak, and Cook Inlet Management Areas. In the Shumagin Islands Section, the majority of fishing effort occurs near Korovin, Popof, and Unga Islands (Figure 2).

In the Shumagin Islands post-June fishery sockeye salmon are harvested in fisheries directed and dominated by pink and chum salmon. The sockeye catches occur on mixed stocks. The Shumagin Islands are basically a "cape fishery" with some terminal pink and chum salmon runs (Shaul 1989). The sockeye catch in the post-June fishery are both local (South Peninsula) and migratory salmon.

The Shumagin Islands fishery is a long standing fishery that has been operating since at least 1911 (Shaul and Schwarz 1989). Post-June sockeye catches have been documented since 1959. Before 1959 sockeye catches were not consistently separated from the other fisheries. Sockeye catches were relatively high during the mid 1960's, 1970, and late 1970's and were low during the early 1960's and mid 1970's (Figure 3). Catches have increased since 1985 and have consistently exceeded the peak catches of the earlier years.

Stock separation analysis methods, including scale digitizing and tagging, to date have been directed primarily on June migratory salmon stocks. Limited salmon tagging has occurred in the Shumagin Islands Section in late June and early July. The earliest tagging study occurred in 1922 (Gilbert 1923) and the latest occurred in 1987 (Eggers et al. 1989). Most of the tagged sockeye salmon have been recovered in terminal fisheries from the North and South Peninsula, Chignik, Kodiak, Bristol Bay, and Cook Inlet management areas. The 1987 tagging study indicated that the June Shumagin Islands Section sockeye catch was predominately from Bristol Bay (60.6%), Chignik (18.5%), Kodiak (9.5%), South Peninsula (5.4%), and North Peninsula (5.3%). The post-June Shumagin Islands Section fishery may be substantially different than the stock composition during June. To date stock composition results have not been determined for sockeye salmon in post-June catches.

Extensive catch sampling has occurred in the Shumagin Islands since 1985-89 (McCullough 1989b). Although the age compositions of the harvests have been determined for those years, stock composition estimates based on scale pattern analysis have not been made.

SHUMAGIN ISLANDS COMMERCIAL HARVEST

The Shumagin Islands Section from July through August are historically managed for local pink and chum salmon runs. Sockeye salmon are a bycatch of this fishery. Whenever pink or chum salmon are abundant, more fishing time is allocated and catches of sockeye salmon increase with the increasing catches of pink or chum salmon.

Numerically speaking pink salmon have contributed the most salmon to the catch and have shown the greatest variability (Figure 4). The bycatch rate of sockeye salmon for the Shumagin Islands was low from 1980 to 1985 (ratio of sockeye to pink salmon, 1:14.0; sockeye to chum salmon, 1:2.5) and increased after 1985 (ratio of sockeye to pink salmon, 1:5.2; sockeye to chum salmon, 1:0.9; Table 2). The increase in sockeye bycatch rate reflects the greater abundance of sockeye in the Shumagin Islands since 1985 and the poor return of local pink salmon in 1987 (Figure 4).

In 1980-85 the post-June sockeye harvest averaged 21.2% of the total yearly sockeye catch, while the 1986-89 post-June sockeye harvest averaged 61.2% of the total yearly sockeye catch (Figure 5).

Since 1980, the post-June pink harvest has ranged from 542,462 (1987) to 3,396,332 (1988) and averaged 1,633,254 salmon (Table 2). During the same period the chum harvest has ranged from 205,899 (1985) to 557,332 (1986) and averaged 307,563 salmon. Similarly the sockeye harvest has ranged from 67,269 (1982) to 418,124 (1989) and averaged 206,005 salmon. The 1980-89 average post-June harvest of all species was 2,344,735 salmon.

The post-June sockeye catch in the Shumagin Islands Section increased substantially after 1985 as compared to previous years (Figure 6). The average sockeye catch for 1980-85 was 105,723 salmon, while the average sockeye catch since 1986 has been 356,435 salmon. The recent increase in sockeye catches may be the combination of several factors: (1) additional fishing effort; (2) higher gear efficiency; (3) greater fish availability through changes in migration patterns; (4) greater fish availability from increased salmon abundance; and (5) expanded fishing areas.

To check the consistency of the pattern of high abundance of sockeye salmon with those of other areas, catches of sockeye salmon from 1959-89 were compared for five areas: Cook Inlet, Kodiak, Chignik, North Peninsula, and Bristol Bay (Figure 7). These data indicate that in recent years a substantial increase in the sockeye catches in Bristol Bay, North Peninsula, Chignik, Kodiak, and Cook Inlet have occurred. The pattern of increased catches since 1979 suggests that the abundance of sockeye in the North Pacific region has substantially increased.

In addition to greater fish availability from larger salmon runs another possible factor leading to increased catches of sockeye salmon is an increase in effort.

In the Shumagin Islands set gill net effort has increased since 1984, while purse seine effort has remained stable with the exception of an increase in 1989 (Figure 8). When limited entry permits were issued up to three different salmon fishing permits were given to an individual South Peninsula fishermen. As South Peninsula fisheries became more competitive many of the multiple permit holders retained their drift gill net or purse seine permit and sold their remaining permits, which was usually the set gill net permit. This explains the recent increase in fishing effort. The set gill net gear level will probably continue to increase until all available 114 set gill net permits and 125 purse seine permits are in use full time within the Alaska Peninsula and Aleutian Islands Management Areas. In 1989 after June, a total of 56 set gill net operators and 83 purse seine operators fished the Shumagin Islands Section. In association with the increased set gill net effort has been an increase in the percent of the catch harvested by set gill net gear (Figure 9).

Associated with the increase in set gill net effort was a decrease in the amount of fishing time available in other lucrative fisheries, such as the Southeast District Mainland fishery. Historically, the Southeast District Mainland fishery was open on a day to day basis with Chignik Lagoon (1974-77), three to five days per week (1978-85), and under the current management plan (1986-89). The Southeast District Mainland fishery from 1 July through 26 July, in accordance with the Southeastern District Salmon Management Plan (ADF&G 1989), did not have a general opening in 1987 and 1989, and opened for two days in 1988. Usually when the Southeast District Mainland is closed the majority of set gill net fishermen move to the Shumagin Islands Section.

In addition to greater fish availability and increased effort another potential factor leading to increased sockeye catches is a change in fishing areas.

Prior to 1986 precise catch and effort statistics within different portions of the Shumagin Islands Section, especially the West side of Unga Island and Nagai Island are not available.

From 1976 to 1985 an average of one post-June purse seine landing occurred annually from the Nagai Island area (Figure 10). Post-June in 1986, seven purse seine operators made landings from there, while in 1989 there were 16 purse seiners. The set gill net effort in the Nagai Island post-June fishery increased from one operator in 1986 to nine operators in 1989. The West side of Unga Island prior to 1986 was fished only occasionally by purse seiners for local chum and pink runs located near Dry Lagoon, Bay Point, and Pinnacle Point. In 1986 fishing effort in this area had increased to 13 purse seine and two set gill net operators and increased further in 1989 to 21 purse seine and six set gill net operators. Fish ticket information also indicated an increase in effort in other portions of the Shumagin Islands Section. In the Korovin, Popof, and Unga (exclusive of the West side of Unga Island) Islands effort increased from 68 purse seine and 39 set gill net operators in 1986 to 85 purse seine and 56 set gill net operators in 1989.

With the increased effort, catches from the West side of Unga and Nagai Islands have also accelerated. The West Unga 1987-89 catches averaged 86,066 sockeye, 7,621 coho, and 286,259 pink salmon (14.2% of the Shumagin Islands total post-June catch). The Nagai Island 1987-89 catches averaged 33,918 sockeye, 6,253 coho, and 184,586 pink salmon (8.5% of the Shumagin Islands total post-June catch).

Fish ticket information for 1987-89 also indicated that the species composition from Nagai Island and West Unga Island was not substantially different than the more traditional fishing areas within the Shumagin Islands Section (Figure 11). Both Nagai Island and West Unga Island had higher sockeye and lower coho bycatch rates than traditional harvest areas. Harvest data indicates that since at least 1987 and probably since 1986 sockeye salmon have been readably available to commercial fishermen throughout the fishery, while prior to 1986 the Shumagin Islands experienced lower abundances of sockeye salmon.

Another method of determining changes in sockeye abundance is from trends in catch per unit of effort data (Figure 12). In traditional Shumagin Islands fishing areas the July sockeye catch per unit of set gill net effort indicates an increasing trend in the availability of sockeye salmon. The average sockeye catch per unit of effort for 1980-85 was 116.9 sockeye per boat day, while the average for 1986-89 was 241.2 sockeye per boat day.

The average 1980-89 peak sockeye catch was during statistical week 28 (about July 5-12), chum salmon during week 30 (about July 20-27), and pink salmon during week 31 (about July 28 - August 4), however inter-year variation in run timing or commercial fishing openings may shift the sockeye peak catch from the average (Figure 13). During the period of time when the majority of sockeye salmon are harvested, the majority of the chum salmon harvest also occurs.

To summarize the available fish ticket information, increased catches of sockeye salmon have occurred since 1986 in the post-June Shumagin Islands Section. The increased catch of sockeye salmon appears to be the result of increased sockeye availability and increased fishing time during years when large pink and chum runs occur and to a lesser extent increased effort.

AGE COMPOSITION COMPARISON

The Alaska Department of Fish and Game has collected commercially harvested sockeye scale samples from all areas that are assumed to be contributing to the Shumagin Islands fishery. One method of comparing the sockeye harvest in the Shumagin Islands Section with other areas is to analyze the age composition of the commercial catches. Because the Chignik Management Area is the closest management area outside of the South Peninsula to the Shumagin Islands Section it was assumed that if Chignik stocks dominated the harvest then the weekly age composition of the harvest between the two fisheries should be similar.

Age two and three-ocean sockeye salmon, (2.2, 1.3, and 2.3) from Chignik and the Shumagin Islands Section post-June fishery were considered in the analysis. In the Shumagin Islands Section from 1985-89 these age classes represented 91.3% of the harvest. Chignik samples were back calculated using a 16 day travel time from Chignik Lagoon to the Shumagin Islands (Eggers et al. 1987).

Although yearly variations of individual age class occur, the post-June age class compositions of the Shumagin Islands Section (McCullough 1987; McCullough 1988; McCullough 1989a; McCullough 1989b; McCullough *In Press*) and Chignik (Probasco et al. 1985; Probasco et al. 1986; Probasco and Fox 1988; Thompson and Fox 1989; Thompson and Fox *In Press*) catches are substantially different. For example; age 1.3 sockeye, those having spent one winter in fresh water and three winters in salt water, were the dominant age class in the Shumagin Islands Section during

statistical weeks 27 through 29 when 51.9% (1980-89 average) of the post-June sockeye harvest occurs (Figure 14). By week 30 age 1.3 sockeye in the Shumagin Islands were a less important component of the harvest but they were more than twice as abundant through week 32 than in the Chignik Area. In Chignik age 1.3 sockeye account for less than 10% of the harvest through week 33. In the Shumagin Islands fishery age 1.3 sockeye were always a major component of the harvest.

Age 2.2 sockeye, those spending two winters in fresh water and two winters in salt water, were the least important of the three major age classes. The total post-June Chignik catch had 23.8% age 2.2 sockeye salmon, while the total post-June Shumagin Islands sockeye catch had 17.4%.

Age 2.3 sockeye, those spending two winters in fresh water and three winters in salt water, represented 64.0% of the total post-June Chignik catch, while in the Shumagin Islands fishery age 2.3 sockeye represented 31.9% of the total post-June catch, about half the Chignik level of age 2.3 salmon.

If Chignik was the dominant stock contributing to the Shumagin Islands fishery the age composition should be more similar between the areas. Since differences occur in the age composition between the two fisheries, stocks in addition to Chignik must be contributing to the Shumagin Islands fishery.

TIMING OF VARIOUS WESTERN ALASKA STOCKS OF SOCKEYE SALMON IN THE SHUMAGIN ISLANDS SECTION

There is no specific information on the stock composition of the post-June sockeye harvest in the Shumagin Islands. Because specific stock composition data is lacking, the potential for various Western Alaska and Upper Cook Inlet sockeye stocks to be present in the Shumagin Islands was evaluated based on the timing of various sockeye catches in their terminal areas (Figure 15).

Timing statistics for 1989 were estimated for Cook Inlet, Kodiak, Chignik, North Peninsula, and Bristol Bay using the 1987 (Eggers et al. 1987) and 1922 (Gilbert 1923) tagging studies. The duration of the run was taken to be the time period encompassing the central 90% of the catch (Figure 16).

These results suggest that there is a great overlap in the timing of Western Alaska and Upper Cook Inlet sockeye stocks especially through mid-July in the Shumagin Islands Section when over 50% (1980-89 average) of the post-June sockeye harvest occurs. The timing of the stocks in the Shumagin Islands also indicate that after approximately 20 July when about 30% (1980-89 average) of the post-June sockeye harvest occurs the dominant stocks are from Kodiak, Chignik, and South Peninsula. Based on these results it is likely that catches in the Shumagin Islands are a mixture of stocks, and the potential exists for all Western Alaska and Upper Cook Inlet sockeye stocks to contribute to the catch.

LOCAL STOCK CONTRIBUTION

Tagging data and run timing of local sockeye stocks also suggests that the potential exists for South Peninsula sockeye stocks to be present in the Shumagin

Islands fishery after June (Eggers et al. 1979; McCullough 1989b). There is no specific information on the harvest of local sockeye stocks in the Shumagin Islands but the potential for various local stocks to contribute to the fishery can be estimated. Assuming that local stocks are exploited at their optimum rate of 67% (Chapman 1986), and knowing the South Peninsula escapement average was 92,197 (1985-89 average), then the potential average contribution of South Peninsula sockeye salmon is 187,189 salmon. This surely overestimates the actual contribution of South Peninsula sockeye stocks to the Shumagin Islands fishery since it is unlikely that all salmon would migrate to local systems through the Shumagin Islands.

DISCUSSION

Currently there is inadequate information to quantify the contribution level of the various stocks in the post-June sockeye harvest in the Shumagin Islands Section. Fleet distribution and inter-year variation in fish migration and many other factors define the contribution of individual stocks to the harvest. We know that potential contributing stocks in June and early July are from the Bristol Bay, Alaska Peninsula, Chignik, Kodiak, and Cook Inlet Management Areas. How many sockeye salmon each management area may be contributing to the post-June Shumagin Islands fishery and whether their contribution changes from year to year is unknown.

The potential may exist through scale pattern analysis and tagging to identify sockeye stocks in the post-June Shumagin Islands fishery to their management area of origin. Extensive and costly escapement and catch sampling of South Peninsula stocks would be necessary. To date sampling operations have not permitted the level of escapement and catch sampling required to define individual stock contribution levels.

SUMMARY

- 1) Local South Peninsula pink and chum salmon are the targeted species for the post-June Shumagin Islands Section "cape fishery".
- 2) The increased catch of sockeye salmon since 1985 in the Shumagin Islands post-June fishery appears to be related to the increased abundance of all stocks contributing to the fishery and increased effort.
- 3) Age compositions of the sockeye salmon catches in the Shumagin Islands and the Chignik fisheries are substantially different which indicates that in addition to Chignik stocks the Shumagin Islands catch is probably a mixture of Western Alaska and Upper Cook Inlet stocks.
- 4) Tagging studies in June and early July indicate that Bristol Bay, Alaska Peninsula, Chignik, Kodiak, and Cook Inlet stocks contribute to the Shumagin Islands Section fishery.
- 5) Based on the run timing of stocks contributing to the fishery in the Shumagin Islands it is very likely that the catches are a mixture of stocks, and the potential exists for all Western Alaska and Upper Cook Inlet sockeye stocks to contribute to the catch.

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Table 1. Commercial sockeye salmon catches in Western Alaska and Upper Cook Inlet by management area, 1960-1989.

Year	Upper Cook Inlet	Kodiak	Chignik	South Peninsula	North Peninsula	Bristol Bay	Total	Post-June Shumagin Islands
1960	923,314	362,000	710,300	379,000	692,800	13,705,000	16,772,414	30,400
1961	1,162,303	408,000	323,500	456,800	387,700	11,913,900	14,652,203	76,381
1962	1,147,573	785,000	364,800	420,000	249,700	471,800	3,438,873	77,406
1963	942,980	407,000	408,600	204,400	2,255,200	2,871,100	7,089,280	55,184
1964	970,055	478,000	557,800	370,800	250,800	5,596,100	8,223,555	146,498
1965	1,412,350	346,000	630,600	915,700	199,500	24,255,200	27,759,350	238,668
1966	1,852,114	632,000	222,100	606,200	245,300	9,314,200	12,871,914	60,930
1967	1,380,062	284,000	467,900	294,100	224,700	4,330,700	6,981,462	80,298
1968	1,104,904	760,000	878,400	699,800	237,100	2,792,800	6,473,004	117,600
1969	692,244	604,000	310,100	912,800	321,300	6,621,698	9,462,142	97,500
1970	746,634	917,000	1,325,800	1,794,600	213,000	20,720,766	25,717,800	167,200
1971	636,798	478,000	1,016,100	715,500	354,200	9,583,987	12,784,585	84,700
1972	879,724	222,000	378,700	557,800	179,500	2,416,233	4,633,957	93,800
1973	670,025	167,000	870,400	330,200	171,800	761,322	2,970,747	42,500
1974	497,160	409,000	662,900	204,700	247,900	1,362,479	3,384,139	72,000
1975	678,736	137,000	399,600	268,400	233,500	4,898,814	6,616,050	49,300
1976	1,664,131	641,000	1,163,700	375,000	641,100	5,619,292	10,104,223	72,000
1977	2,052,511	623,000	1,972,200	311,700	471,100	4,877,880	10,308,391	46,000
1978	2,621,667	1,072,000	1,576,300	579,500	896,200	9,928,139	16,673,806	119,100
1979	924,415	632,000	1,049,700	1,149,700	1,979,500	21,428,606	27,163,921	145,369
1980	1,573,637	651,000	860,000	3,474,562	1,397,100	23,761,746	31,718,045	138,438
1981	1,439,235	1,289,000	1,839,500	2,138,903	1,844,900	25,603,081	34,154,619	116,297
1982	3,259,864	1,205,000	1,522,500	2,278,731	1,435,300	15,104,391	24,805,786	67,269
1983	5,049,733	1,232,000	1,824,200	2,448,235	2,093,400	37,372,031	50,019,599	108,365
1984	2,105,860	1,951,000	2,662,500	2,221,851	1,734,900	24,710,306	35,386,417	96,149
1985	4,060,260	1,843,000	946,369	2,106,761	2,600,589	23,702,883	35,259,862	107,792
1986	4,787,982	3,155,000	1,645,834	881,278	2,463,735	15,888,582	28,822,411	341,811
1987	9,500,186	1,793,000	1,898,838	1,200,819	1,209,435	16,047,834	31,650,112	248,887
1988	6,834,342	2,698,000	795,841	1,056,719	1,528,116	13,863,917	26,776,935	416,917
1989	5,010,698	1,289,536	1,159,287	2,663,440	1,718,109	28,689,920	40,530,990	418,124
Ave., 1960-89	2,219,383	915,685	1,014,812	1,067,267	949,249	12,940,490	19,106,886	131,096
Ave., 1960-85	1,555,703	712,885	959,407	1,008,298	829,157	12,066,325	17,131,775	96,429
Ave., 1986-89	6,533,302	2,233,884	1,374,950	1,450,564	1,729,849	18,622,563	31,945,112	356,435

Table 2. Shumagin Islands Section commercial salmon harvest by species, post-June, 1980-89.

Year	Number of Salmon					Total
	Chinook	Sockeye	Pink	Chum	Coho	
1980	1,380	138,438	1,545,827	262,462	233,456	2,181,563
1981	4,009	116,297	1,364,026	307,980	126,955	1,919,267
1982	1,889	67,269	1,638,712	296,426	207,273	2,211,569
1983	6,547	108,365	900,726	220,824	92,403	1,328,865
1984	3,222	96,149	1,786,737	259,497	211,648	2,357,253
1985	461	107,792	1,632,827	205,899	113,193	2,060,172
1986	3,121	341,811	1,497,892	557,332	201,518	2,601,674
1987	3,388	248,887	542,462	310,533	157,906	1,263,176
1988	5,955	416,917	3,396,332	415,308	351,118	4,585,630
1989	2,493	418,124	2,026,996	239,366	251,206	2,938,185
Avg., 1980-89	3,247	206,005	1,633,254	307,563	194,668	2,344,735
Avg., 1980-85	2,918	105,718	1,478,143	258,848	164,155	2,009,782
Avg., 1986-89	3,739	356,435	1,865,921	321,736	240,437	2,847,166
Ratio Sockeye to Pink 1980-89	1 : 7.9					
Ratio Sockeye to Chum 1980-89	1 : 1.5					
Ratio Sockeye to Pink 1980-85	1 : 14.0					
Ratio Sockeye to Chum 1980-85	1 : 2.5					
Ratio Sockeye to Pink 1986-89	1 : 5.2					
Ratio Sockeye to Chum 1986-89	1 : 0.9					

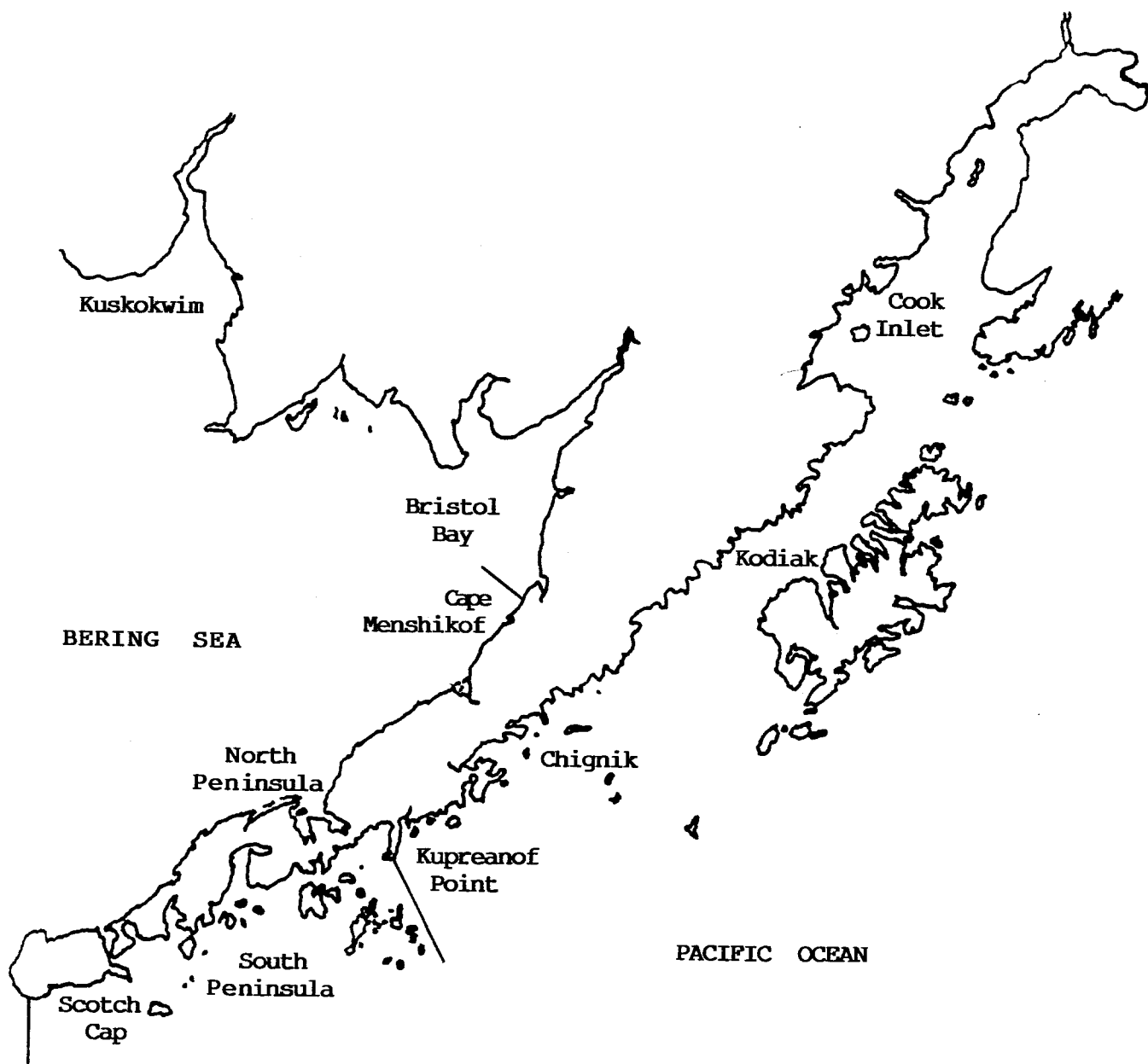


Figure 1. Map of Western Alaska.

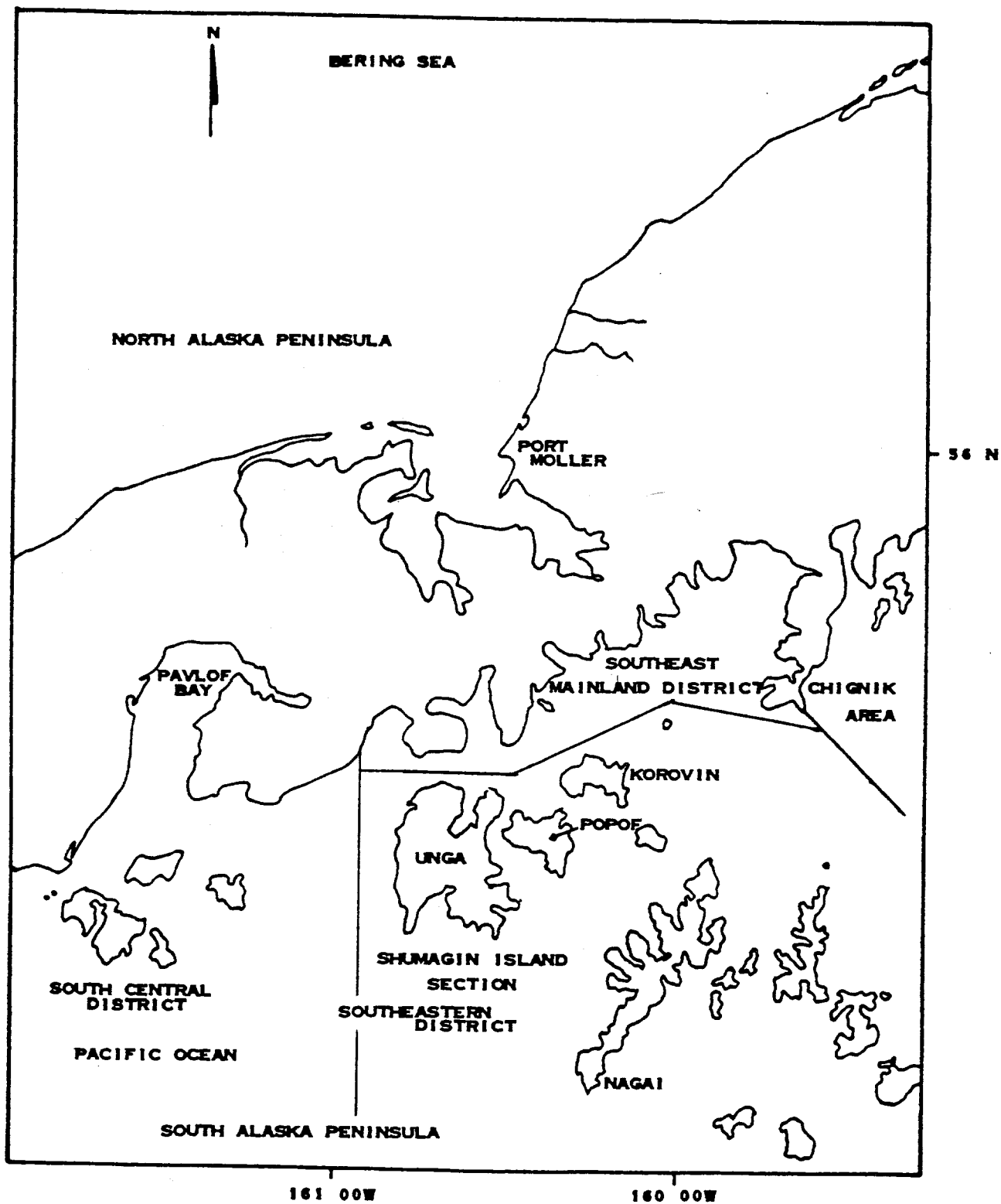


Figure 2. Map of the Shumagin Island Section, Southeast Mainland District, and the Pavlof Bay Area.

Shumagin Islands Post-June Sockeye

Harvest 1959-1989

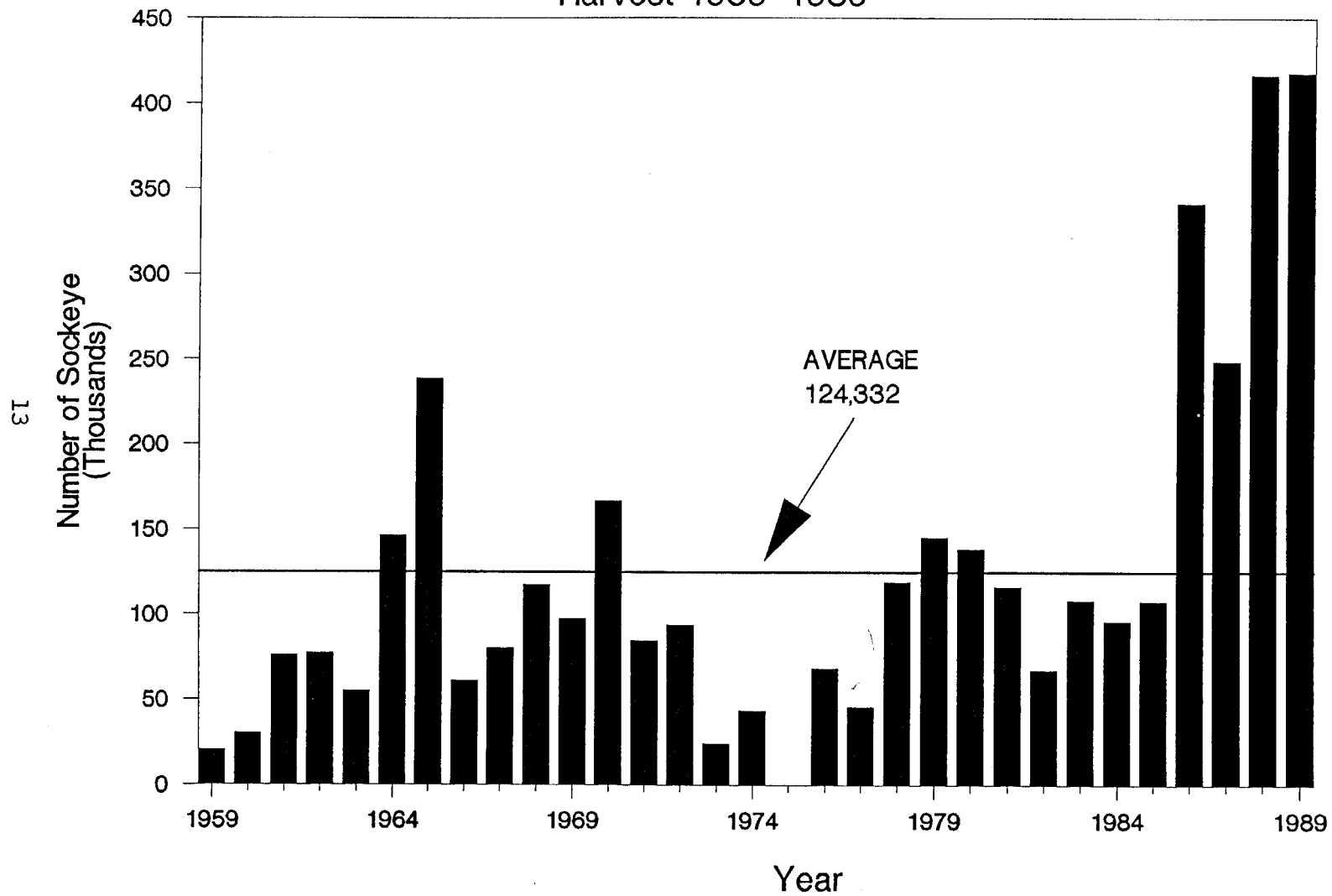


Figure 3. Shumagin Islands Section post-June sockeye harvest, 1959 through 1989.

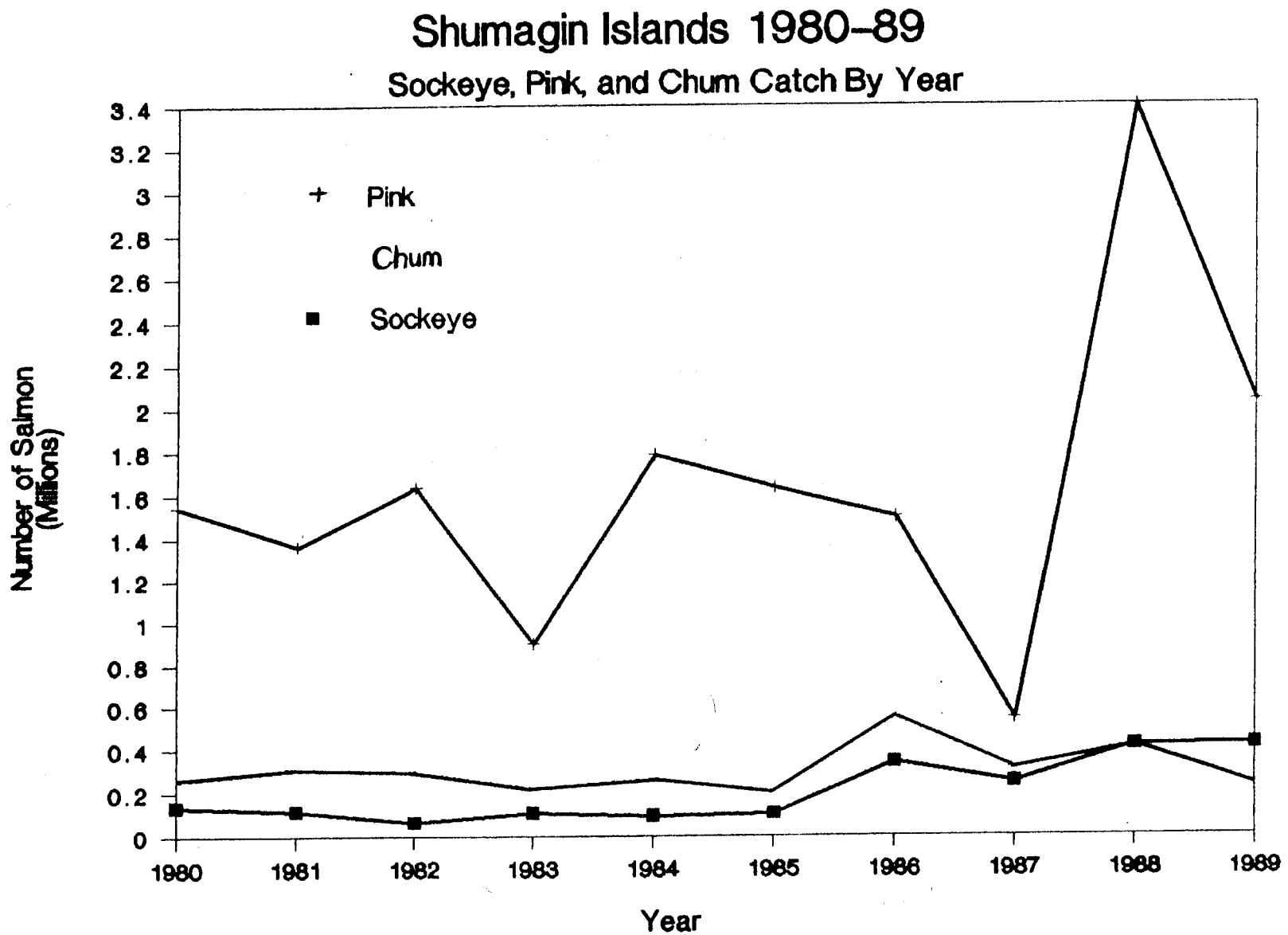


Figure 4. Shumagin Islands Section post-June sockeye, pink, and chum salmon catch, 1980-89.

Shumagin Islands Sockeye Harvest

By Statistical Week, 1980-85 & 1986-89

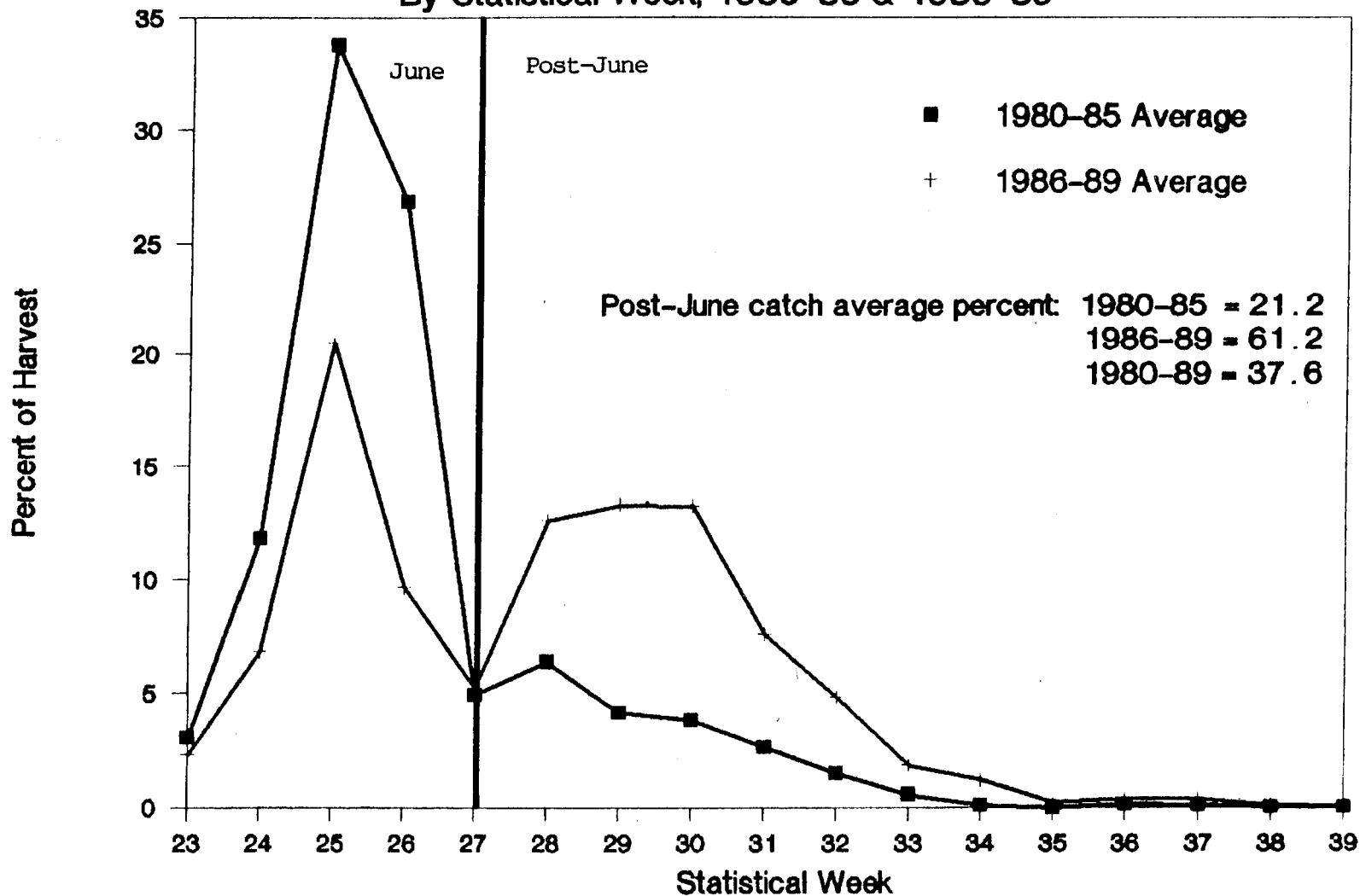


Figure 5. Shumagin Islands Section sockeye harvest by statistical week, 1980-85 and 1986-89.

Shumagin Islands Sockeye Catch

Post-June, 1980-89

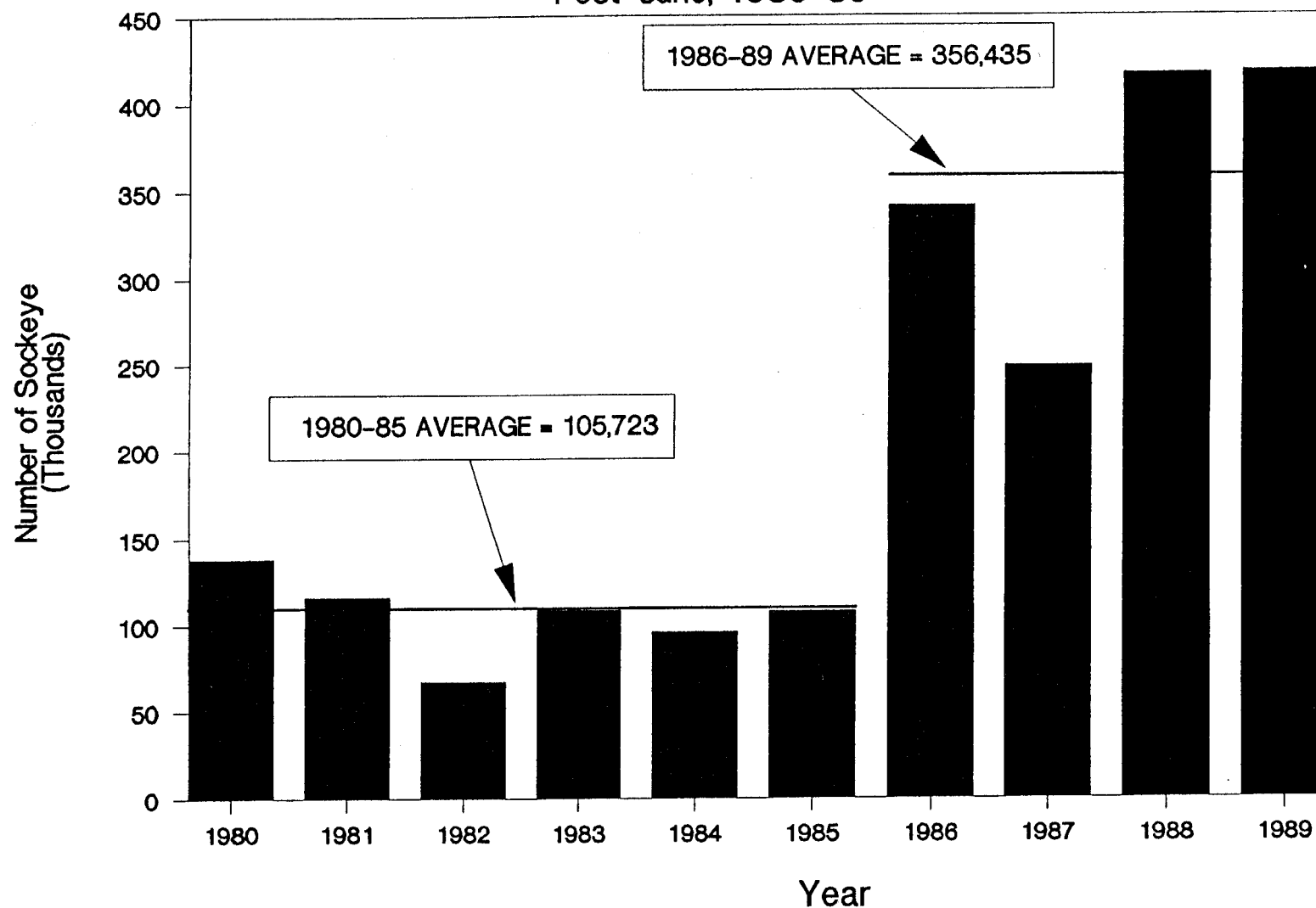


Figure 6. Shumagin Islands Section post-June sockeye catches, 1980-89.

TRENDS IN WESTERN ALASKA SOCKEYE CATCH TOTAL WESTERN ALASKA AND SHUMAGINS

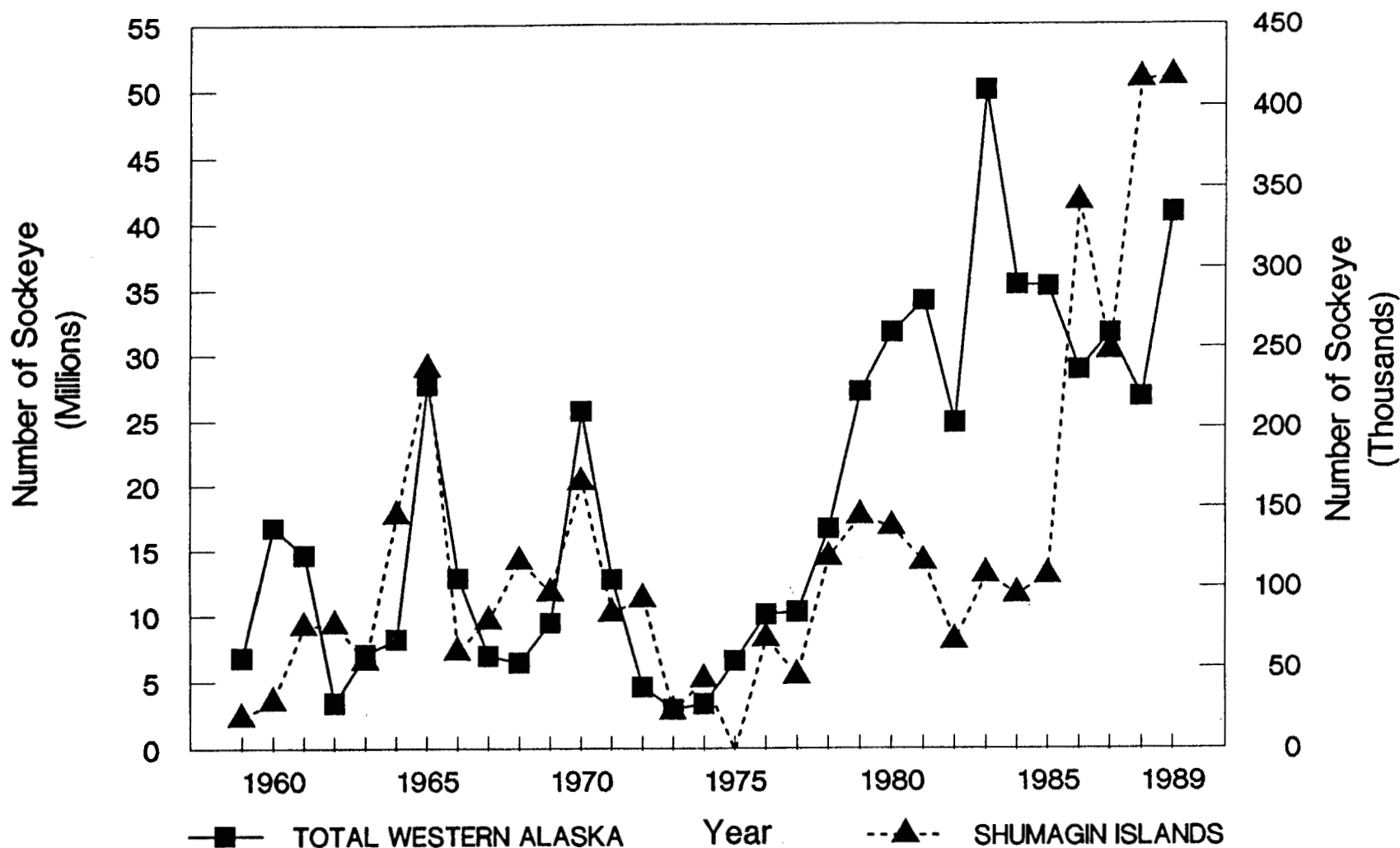


Figure 7. Commercial sockeye harvests in Western Alaska (Cook Inlet, Kodiak, Chignik, North Peninsula, and Bristol Bay combined) in comparison to the post-June sockeye harvest in the Shumagin Islands Section, 1959-89.

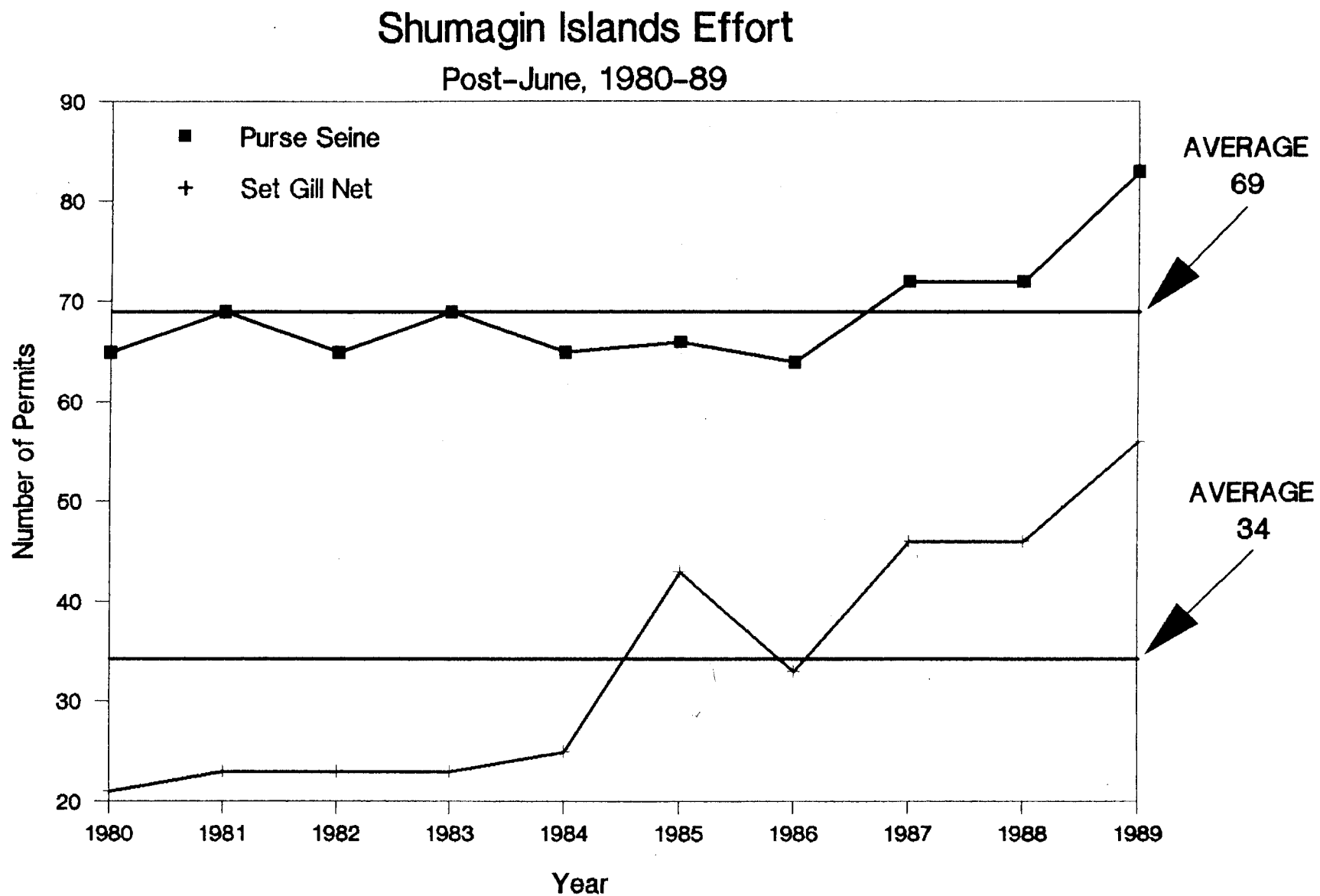


Figure 8. Shumagin Islands Section post-June fishing effort by gear type, 1980-89.

Shumagin Islands Post-June Sockeye

Set Gill Net and Purse Seine Catch

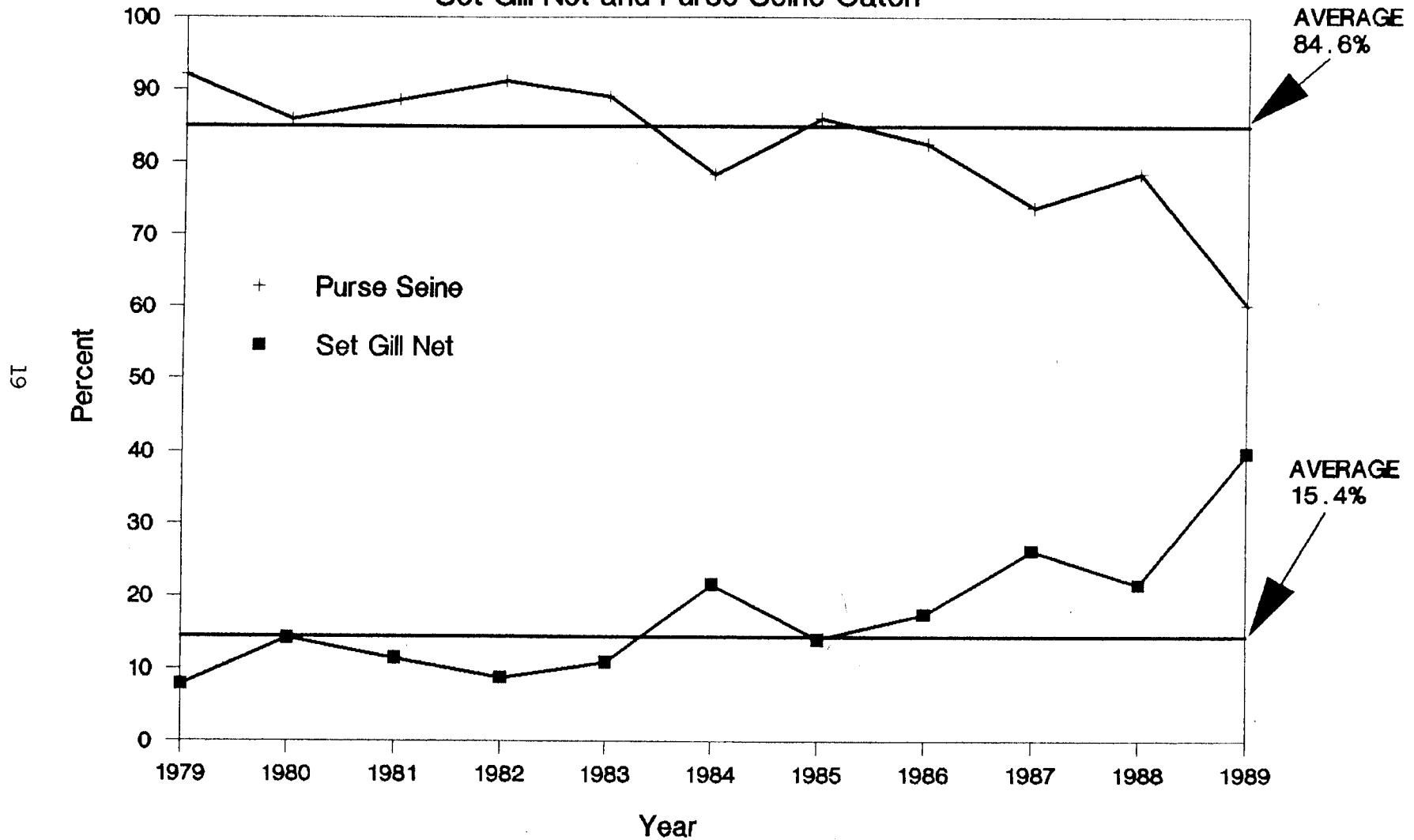
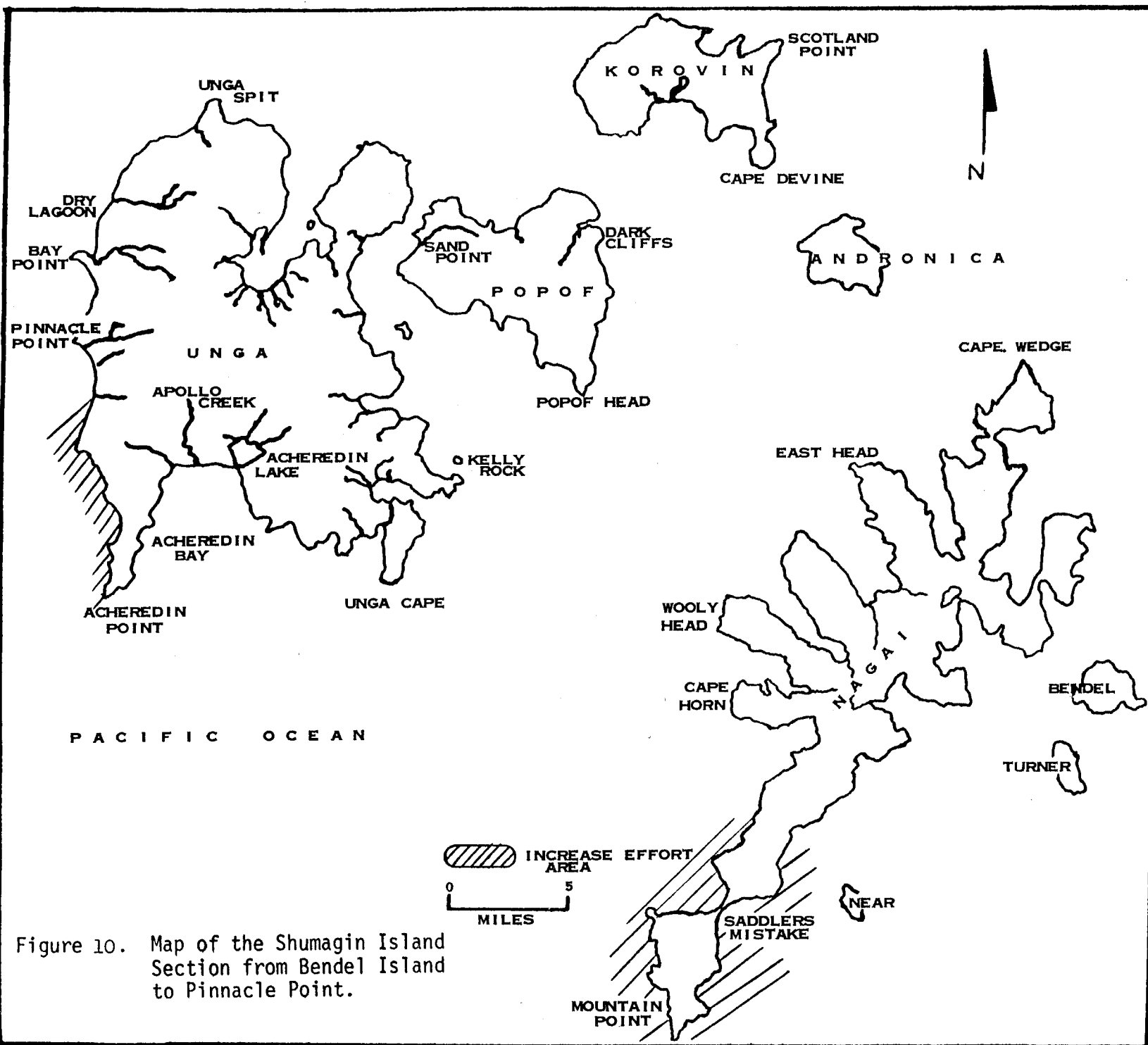


Figure 9. Shumagin Islands Section post-June sockeye catches by gear type, 1979-89.



SHUMAGIN ISLANDS POST-JUNE 1987-89 SPECIES COMPOSITION

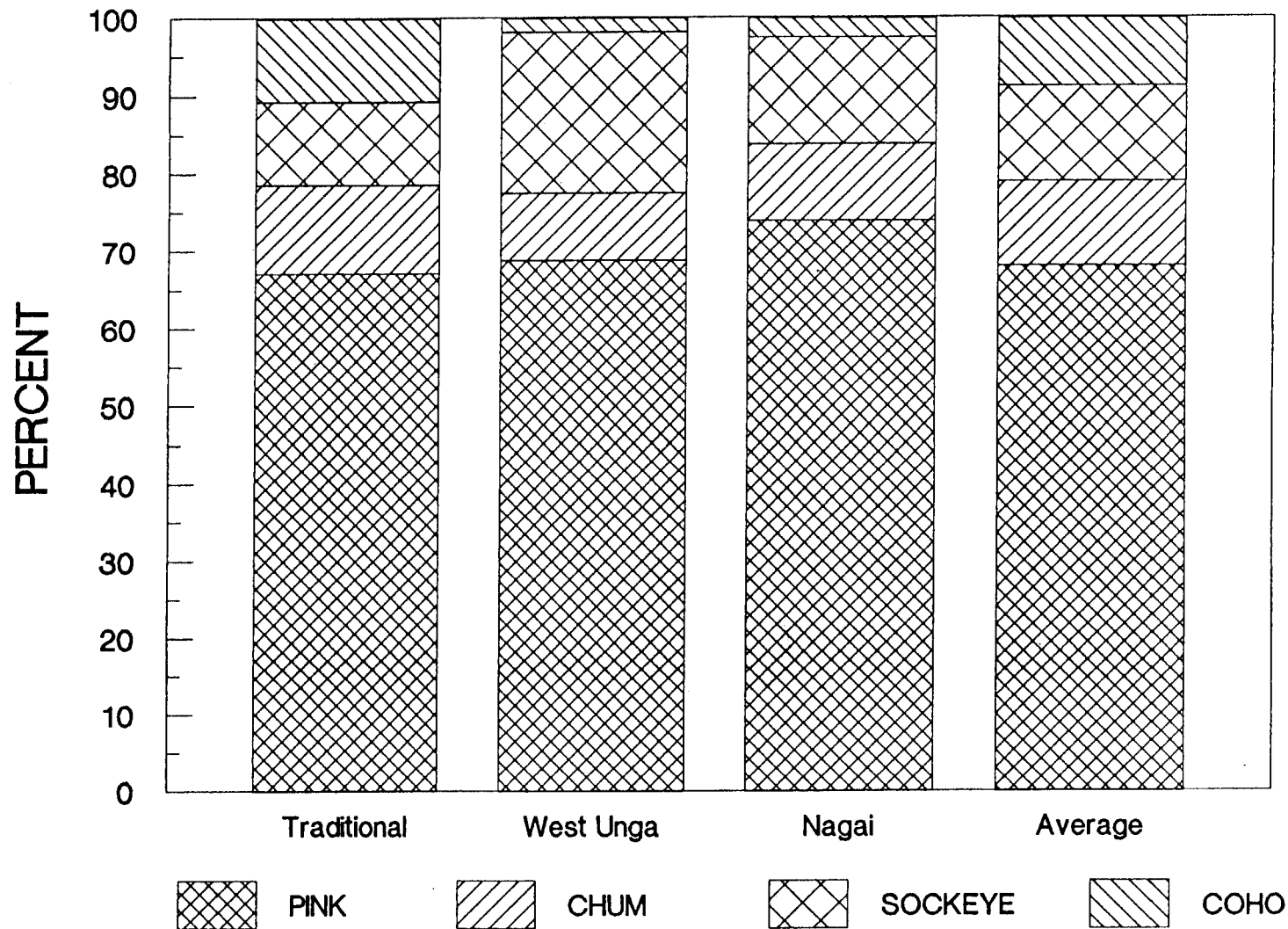


Figure 11. Species composition of the post-June salmon catches in the traditional, West Unga, and Nagai Island fisheries of the Shumagin Islands Section, 1987-89.

SHUMAGIN ISLANDS JULY SET GILL NET C.P.U.E. FOR SOCKEYE SALMON

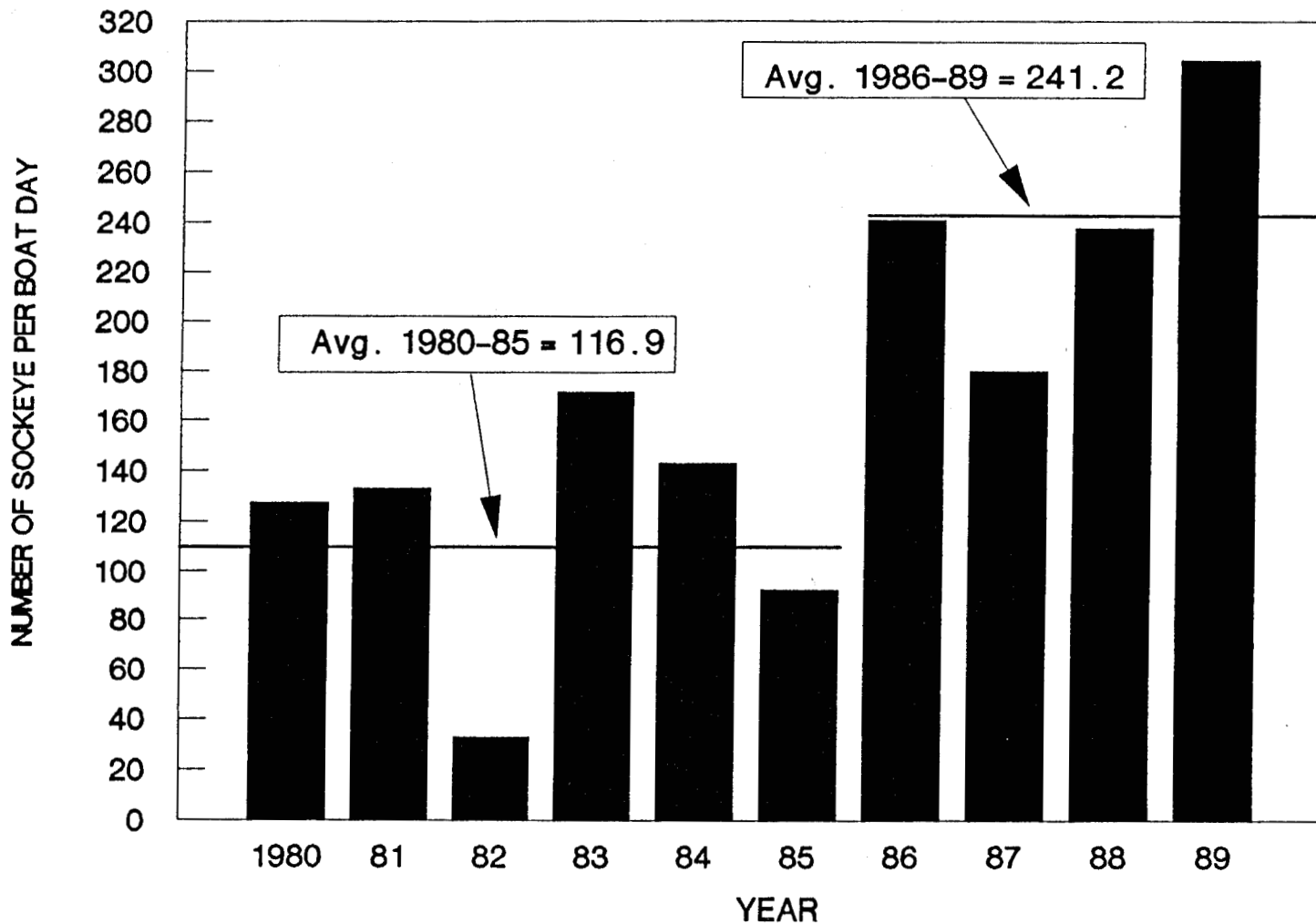


Figure 12. Shumagin Islands Section July sockeye set gill net catch per unit effort (number of sockeye per boat day), 1980-85 and 1986-89.

Shumagin Islands 1980-89 Average

Sockeye, Pink, and Chum Catch By Week

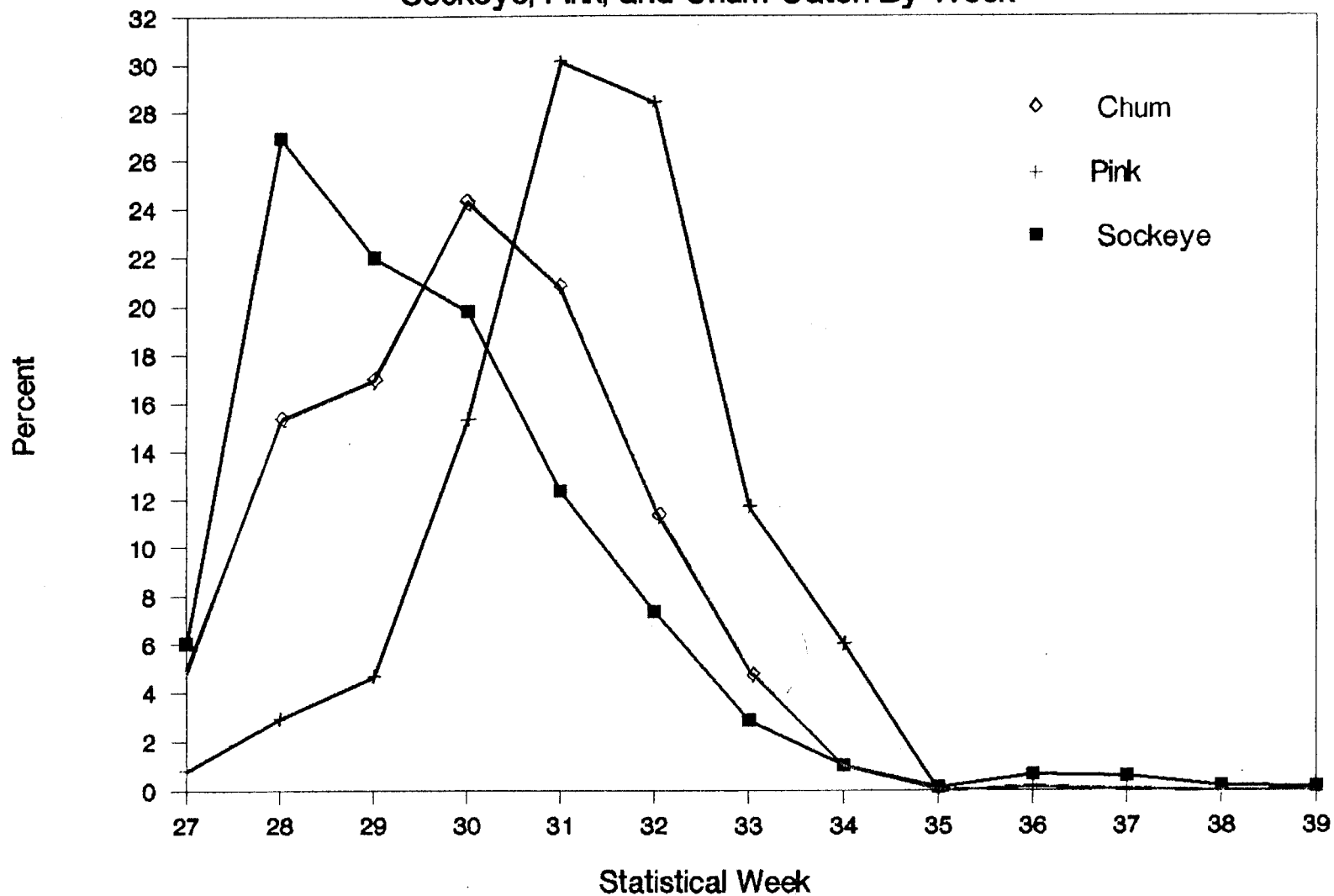


Figure 13. Average Shumagin Islands Section post-June sockeye, pink, and chum salmon harvest by statistical week, 1980-89.

SHUMAGIN ISLANDS AND CHIGNIK POST JUNE AVERAGE 1985,1987,1988,1989

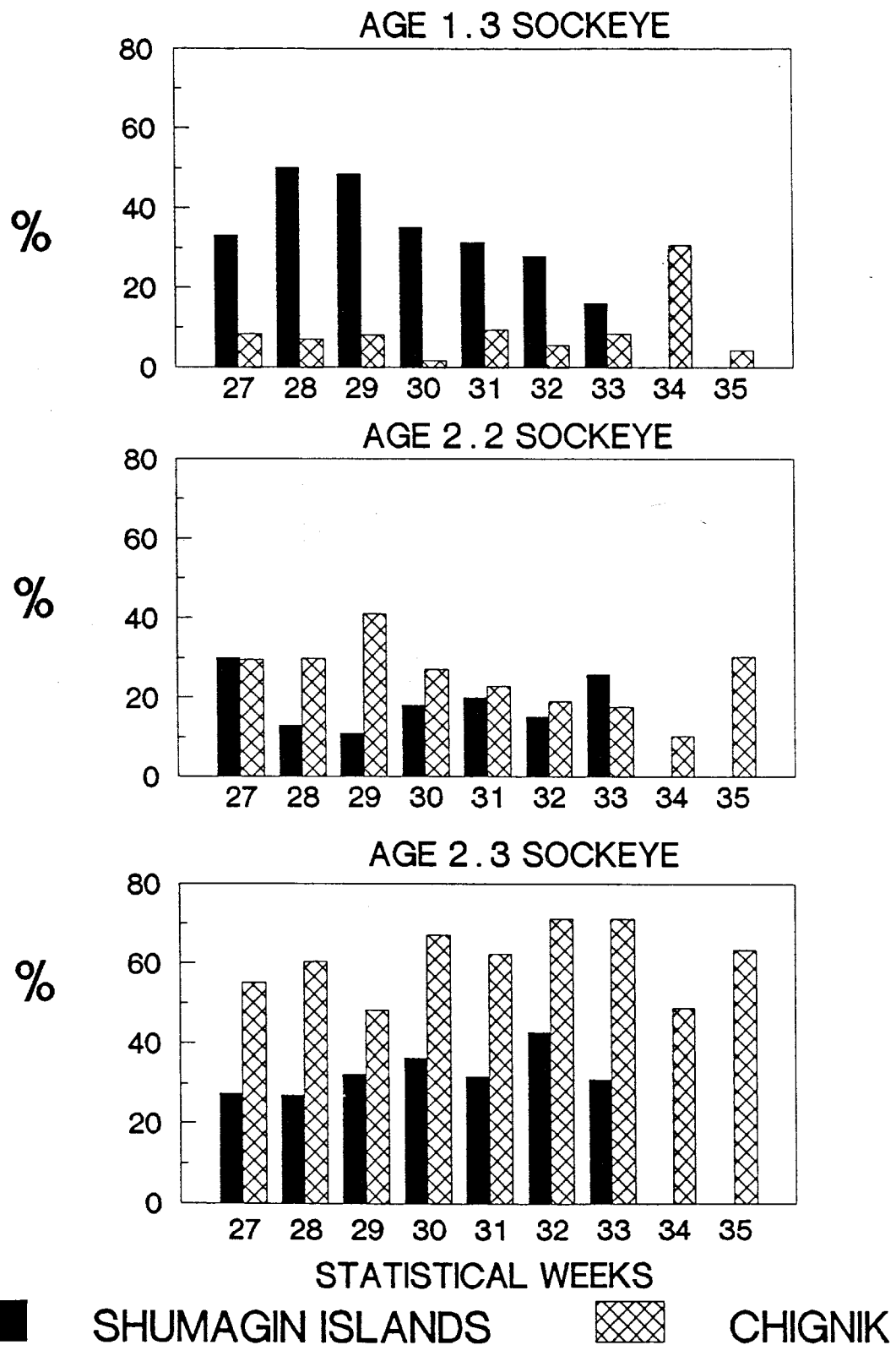


Figure 14. Average estimated age composition of post-June sockeye salmon catches from the Shumagin Islands Section and Chignik, 1985 and 1987-89.

TIMING OF SOCKEYE SALMON CATCHES IN WESTERN AND CENTRAL ALASKA HARVEST AREAS

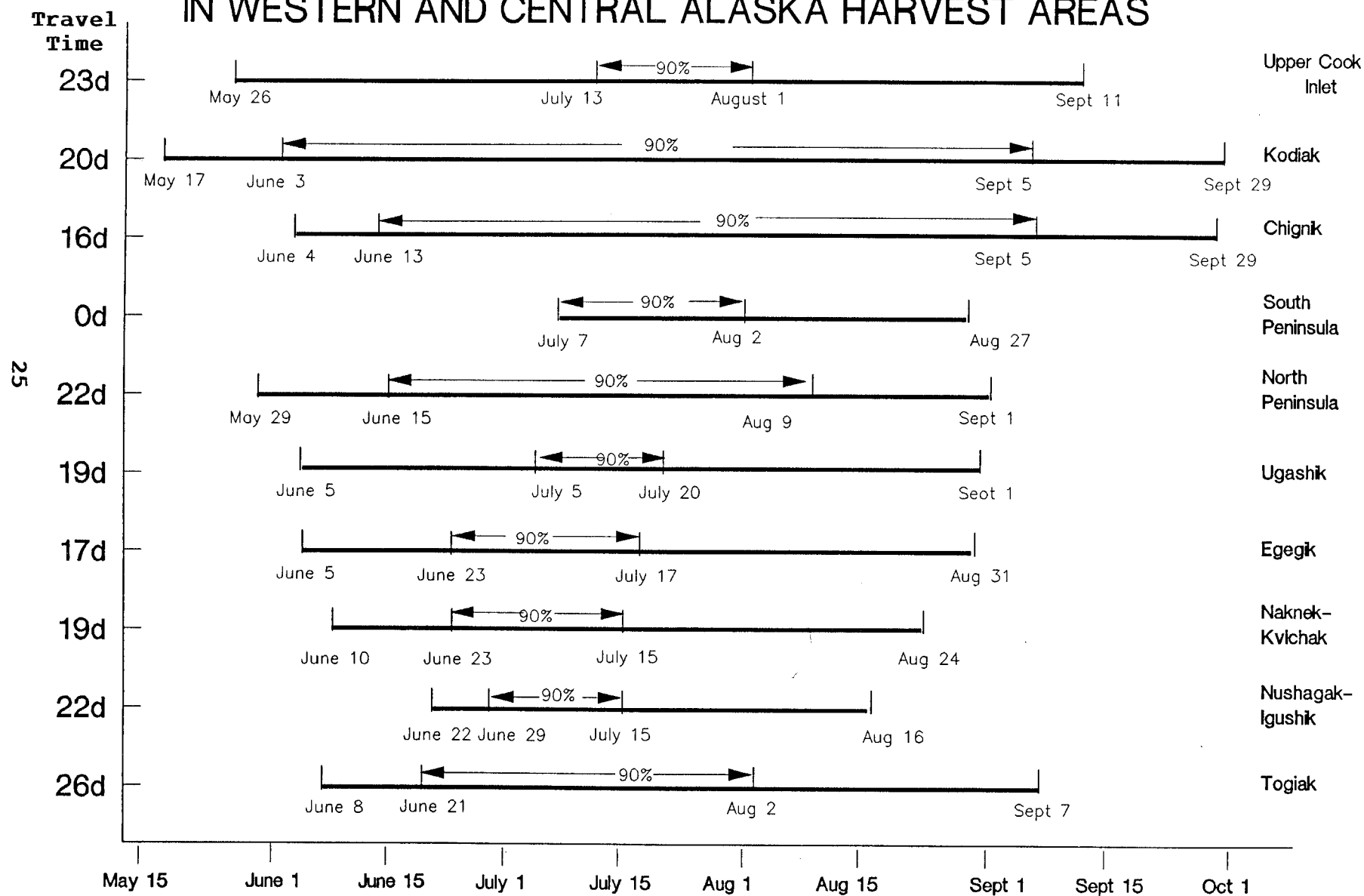


Figure 15. Timing of the 1989 commercial sockeye catches for various terminal harvest areas of Western and Central Alaska.

CALCULATED TIMING OF SOCKEYE SALMON IN THE AREA OF THE SHUMAGIN FISHERY

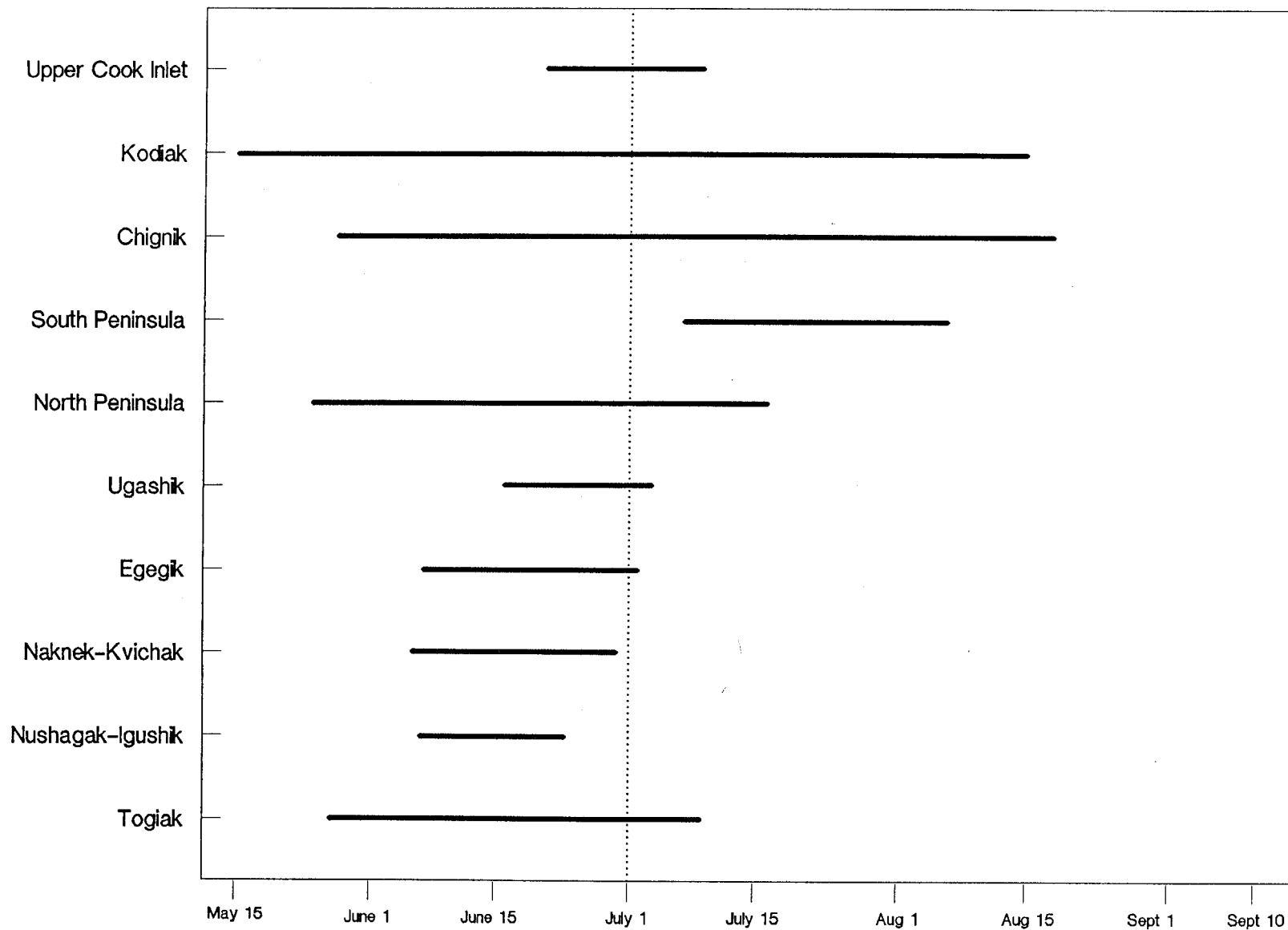


Figure 16. Timing of the central 90% of the 1989 run in the Shumagin Islands Section for various Western and Central Alaska sockeye stocks.

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